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ABSTRACT

This workbook for teaching a biology course is organized into three sections: (1) teacher guidelines; (2) suggested experiments; and (3) apparatus requirements and evaluation schemes. Some of the topics covered in the 30 biology experiments contained in this book include soil analysis, geotropism, bowfly larvae, germination, seed dispersal, flower structure, transpiration, energy in food, testing urine, testing for starch, enzyme reactions, and temperature regulation. Detailed safety and equipment instructions as well as worksheets are provided for each activity. (DDR)

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A Practical Workbook for CXC Biology

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Series of Caribbean Volunteer Publications

#1

One of a series of publications produced by VSO volunteers in the Caribbean. Production funded by a grant from **British Development Division, Caribbean.**

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PRACTICAL WORKBOOK FOR CXC BIOLOGY

Produced by
Voluntary Service Overseas
and
British Development Division
BARBADOS

FOREWARD

Voluntary Service Overseas, an independent British charity, is responsible for the deployment of some seventy volunteers currently working in various parts of the Caribbean, about a third of whom are science teachers. In the past, workshops have been organised annually for these teachers in an effort to adapt their teaching skills to the requirements of the recently introduced CXC syllabus. This year, however, it was considered more beneficial in the long term to hold a series of workshops on individual islands that would be attended by both volunteers and their science teaching colleagues. The production of these six workbooks is designed to coincide with these workshops and to provide a useful resource package for the schools thereafter.

VSO would like to express its gratitude to Mike Ratcliffe, British Development Divison's Regional Science Education Adviser to the Caribbean, and John Kuusk, VSO volunteer science teacher at Anglican High School, Bequia, St Vincent, who are responsible for compiling the materials; to all the science teachers throughout the Eastern Caribbean whose suggestions and comments have proven to be a most valuable resource and guide; and to the British Development Division for its contribution to the costs of production.

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ACKNOWLEDGEMENTS

VSO would like to extend their appreciation and gratitude to the following people who have made this series of publications possible:

- British Development Division (BDDC) for providing the funding for this series of publications

- Volunteers and local colleagues contributing to production of publications.

- Organisation of Caribbean Overseas Development (OCOD) for assisting in the reproduction of these publications

PRACTICAL WORKBOOK

FOR

CXC BIOLOGY

INTRODUCTION

1. This workbook is a revised edition of the 'Practical Worksheets for CXC Biology' developed in 1983. Many of the experiments in the original booklet have been replaced. The mark schemes have been completely overhauled to fit in with the CXC Biology SBA criteria.

2. In addition a brief section with some guidelines on SBA have been included. These guidelines are edited extracts from the discussions of the Biology Group at the CXC/BDD Regional Science Workshop held in February 1985. The note reflect the experience of CXC Biology teachers in the Region. For more detailed information teachers should consult the 'CXC Biology Teachers Resource Booklet'.

3. Teachers should remember that the experiments in the booklet are suggestions, they are not those prescribed by CXC. Efforts have been made to include practicals which cover the SBA criteria comprehensively. Nevertheless, teachers are at liberty to modify and select according to their local circumstances. Similarly, the mark schemes are included as a general guide. They are by no means definitive and comprehensive. Nevertheless, it is hoped that teachers of CXC Biology will find the workbook useful.

Further copies can be obtained from:-

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Regional Science Education Adviser
c/o Ministry of Education
Roseau
Dominica

Tel. 3363

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CONTENTS

Section A	:	Teachers Guidelines for SBA
Section B	:	Suggested Experiments
Section C	:	Apparatus Requirements and Mark Schemes

NOTE: A list of the experiments is given on the next page.

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PRACTICAL WORKSHEETS FOR CXC

BIOLOGY

Contents:

1. Investigating exhaled air.
2. An investigation into breathing.
3. The effect of exercise on the pulse rate.
4. Temperature regulation.
5. The use of hair in temperature control.
6. Bones.
7. Eye dissection.
8. A model cat.
9. The effects of different solutions on Potato tissues.
10. Yeast and oxygen.
11. Testing for starch in a plant leaf.
12. Testing urine.
13. The effect of a enzyme on starch.
14. The action of pepsin on egg white.
15. The action of the enzyme catalase.
16. Energy in food.
17. Burning peanuts.
18. Using a key.
19. Measuring the rate of transpiration.
20. Gaseous exchange in leaves.
21. Flower structure.
22. Seed dispersal.
23. The conditions for germination.
24. Germination
25. Geotropism.
26. Stored food.
27. Investigating Blowfly larvae.
28. Investigating Woolice.
29 Soil analysis.
30 Drainage and water retention.

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TEACHERS GUIDELINES FOR SBA IN CXC BIOLOGY

1. Teachers have experienced considerable problems in assessing Manipulation and Work Habits (Attitudes) particularly with large classes. It is recommended that teachers use a Checklist of the criteria/skills to be assessed during direct assessment in a lesson. Clearly before such a Checklist can be drawn up a detailed breakdown of the skills is required. Some guidelines for Attitudes and Manipulation are given below. For the Work Habits (Attitides) assessment, it may not be possible always to find suitable experimental work. Assessment over a longer term is helpful.

Detailed Breakdown of Attitudes and Manipulative Skills

2. See Pages B - G.

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PAGE B

ATTITUDES

LABORATORY CONDUCT:

Self reliance, resourcefulness, willingness to tackle problems.

Enthusiasm, perseverence

Safety consciousness for self and others

Economical use of materials

Ability to work as part of a team

Helpfulness in general running of laboratory

Awareness of limitations and assumptions of science.

While most of the above may be assessable in particular laboratory experiments, the area of Social Awareness is not so easily tied to any particular experiment. More global assessments over a period of time may be neccesary here.

POSSIBLE CRITERIA FOR ASSESSING

USE OF THE BURETTE

1. Burette rinsed with distilled water then with the solutions with which it is to be filled.

2. Filling
   - use of funnel recommended
   - ensuring tip is full of liquid
   - ensuring no air bubbles
   - removing hanging drops

3. Reading
   - ensuring burette is straight (not tilted)
   - reading at eye level
   - reading the bottom of the meniscus
   - accurate interpretation of scale
   - ensuring that if white paper placed behind meniscus when taking the first reading, the same thing is done for the second reading

4. Manipulating the tap - correct positioning of fingers and thumb around the tap.

USE OF THE PIPETTE

1. Pipette rinsed with distilled water then with the solution with which it is to be filled.

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PAGE C

2. Filling
   - tip kept below level of liquid
   - forefinger used when adjusting level of meniscus
   - pipette held by the stem and not the bulb
   - ensuring bottom of meniscus is level with mark (check with eye level with mark)
   - removing hanging drops.

USE OF CONICAL FLASK (FOR TITRATION)

1. Rinsed with distilled water only.
2. During titration - flask held near the top while swirling and not allowed to hit the end of the burette - allowed to stand on a white background for viewing colour changes.

USE OF THE MEASURING CYLINDER

1. Ensuring that cylinder is resting on a flat even surface
2. Reading the meniscus at eye level
3. Reading the bottom of the meniscus
4. Accurate interpretation of scale

USE OF THE THERMOMETER (in a liquid)

1. Immersion of bulb completely in liquid
2. Lack of contact of bulb with container
3. Stirring liquid to ensure even distribution of heat
4. Immersion time adequate for equilibration
5. Reading taken while bulb is immersed
6. Reading taken at eye level
7. Careful handling and temporary storage to prevent breakage
8. Accurate interpretation of scale

HEATING

USE OF THE BUNSEN BURNER

1. Lighting
   - air holes closed before lighting
   - match lit <u>before</u> turning on the gas.
2. Adjusting flame
   - air holes opened to obtain a non-luminous flame
   - size of flame controlled by adjusting the gas tap.

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USE OF THE TEST TUBE HOLDER

Test tube gripped high enough so test tube holder not held in flame.

USE OF TEST TUBE

1. Held in hottest region of flame

2. Heating solids
   - use of dry test tube
   - angle held:- If liquid seen condensing on cooler part of tube, the mouth of the tube slanted downwards just enough to prevent liquid running back on the hot part of the test tube

3. Heating liquids
   - test tube held pointing away from self and neighbours
   - direction of shaking (around not up and down)
   - volume heated (not more than half full)
   - controlled heating (not boiling if instructed to warm: if required to boil removing tube at intervals to let boiling subside).

USE OF EVAPORATION DISH

1. Heated over a direct flame for stable substances

2. Heated over a waterbath for substances that decompose on strong heating or to avoid spitting e.g. when evaporating sodium chloride solution to dryness.

GAS TESTING

Colour: Before looking down into the test tube:-

1. Test tube removed from flame.
2. Test tube held a safe distance from the eye

Odour: Safety precautions observed:-

1. Mouth of the test tube held on a level with the nose then
2. Hand used to waft the gas towards the nose.

Use of splint (glowing/lighted)

Time inserted - when sufficient gas produced.

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Use of Test Papers

1. Indicator paper first moistened with distilled water
2. Placing of test papers across the mouth of the test tube
3. Economical use of test paper - just enough to fit across the mouth of the tube.

Testing with limewater

Methods -

(i) Bubbling gas into limewater

(ii) Pouring the gas into limewater

(iii) Inserting glass rod dipped in limewater into the gas.

1. Timing - ensure gas is tested while it is being generated/when enough gas is produced.
2. Proper assembly of apparatus/pouring and mixing of gas and limewater/inserting of glass rod so it does not touch the side of the test tube or come in contact with acid spray.
3. For method (i) if tube is heated (e.g. for the decomposition of a carbonate) - removal of the limewater tube from the delivery tube before removing the heated tube from the flame.

HANDLING REAGENTS

1. Precautions to prevent contamination

Care of stopper - correct temporary storage
- replaced immediately after use of the reagent

Reagents already poured out not to be returned to reagent bottles

2. Protection of labels -

Pouring away from the label (hand placed over the label).

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LOOKING AT SOME BASIC PRACTICAL ACTIVITIES

These activities are required in all science subjects - not only Biology.

Example 1 Use of test tube

Possible criteria for assessing

1. angle at which test tube is held (away from self and neighbours)
2. direction of shaking of test tube
3. position of test tube holder
4. holding test tube so as to see whatever goes on inside
5. pouring from test tube to avoid damage to label
6. avoiding spillage
7. quantity of substance placed inside test tube
8. having a rest/rack available for test tube
9. checking test tube for soundness, cleanliness before using
10. ensuring that test tube is made of correct material before using

Example 2 Using a measuring cylinder

Possible criteria for assessing

1. ensuring cylinder is resting on a smooth, flat surface
2. reading meniscus at eye level
3. reading bottom of meniscus

} The only way to check these is by the teacher also doing the reading

4. interpreting the scale/accuracy of scale

Example 3 Reading a thermometer

Possible criteria for assessing

1. immersion of bulb completely in liquid
2. lack of contact of bulb with container
3. immersion time adequate for equilibration
4. reading taken while bulb immersed
5. reading level at eye level
6. careful handling to prevent breakage (NB Mercury)
7. pre-treatment (swirling) of liquid to ensure uniformity
8. rating/interpreting scale accurately

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Example 4 Handling Reagents

Possible criteria for assessing

1. replace stoppers immediately
2. ensure correct temporary storage of stoppers
3. bottles to be returned to proper resting place immediately
4. read labels on bottles
5. use only small quantities of reagents
6. avoid contamination of stock bottles, eg. by not returning reagents already poured out
7. labels should face upward while being poured
8. any droppers used for transfer not to be in contact with sides, bottom of containers
9. mouth of reagent bottle should not be in direct contact with rim of container
10. dispose correctly of any waste/excess
11. wash hands after use of any reagent

Example 5

1 Selected task: Student is to make a drawing of a fish

Task analysis:

1. observing closely and drawing clearly
2. (a) labelling parts accurately
   (b) giving drawing a title or legend
   (c) stating scale of drawing

1. labelling should not be in cursive writing and should be consistent
2. labelling lines should not cross
3. labelling lines should end clearly on the structures they indicate
4. labelling of structures should be factually correct

1. drawing to be made in pencil using clean, continuous lines
2. drawing to be free from any shading
3. drawing should be an accurate representation
4. drawing should be large and clear

1. correct title
2. appropriate additional information in the legend (view)
3. scale stated
4. scale accurate
5. position of legend

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CXC BIOLOGY

SBA Example, Investigating how external factors affect plant Movement

3. Aim: to investigate the effect of gravity on root growth?

Teacher's Note

1. germinate a large number of maize grains and pea seeds. Allow 3-4 days for germination
2. petri dishes or jars
3. cotton wool, toilet paper or other suitable absorbent material
4. transparent tape
5. wooden stands or beakers or plasticine

Task Analysis

1. Setting up apparatus
   (a) obtain petri dish with lid (or jar)
   (b) place damp material in dish (if jar is used line it with a roll damp paper)
   (c) select two seedlings with straight radicles about 5-6 cm long
   (d) place seedlings on damp material in petri-dish (or between damp paper and jar
   (e) arrange seedlings so that their radicles are in various positions eg. vertical, horizontal, etc.
   (f) cover dish and secure lid with transparent tape so that the seedlings are firmly pressed against the damp material
   (g) fix the dish in upright position using wooden blocks, plasticine or other appropriate material (if jar is used place it horizontally
   (h) leave in darkness
   (i) re-examine seedlings after 1-2 days and record observations
   (j) interpret observations by answering questions given

Objectives which could be assessed

Obs 1, 4
Interpretation 1,2,3
Planning & Designing 1,2,3,4
Drawing 1,2,3,4

Objectives selected for assessment

Interpretation 2: draw logical conclusions from data

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Criteria for assessment

Answers to questions below:

1. In which direction did the radicles grow?

   (a) The radicles have grown downwards — expected answer

2. What factor is responsible for the direction of growth?

   (b) The factor is gravity — expected answer

3. Of what use is this response in the life of the plant?

   (c) It allows roots to grow down into the soil -

   (I) for anchorage

   (II) to get water and mineral salts — expected answer

The Rating Scale

a + b + c (I) and (II)	4 marks
a + b + c (I) or (II)	3 marks
[illegible] c (I) or (II)	2 marks
Any one point	1 mark
No points	0 marks

Interpretation 3: assess limitations of observations & data

Criteria for assessment

Answer the following question.

What other factor(s) present in the dish could have an effect on the growth of the radicle?

(a) Humidity of the atmosphere
(b) Presence/absence of light
(c) Temperature

} expected answers

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SECTION B

SUGGESTED EXPERIMENTS

FOR

CXC BIOLOGY

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1. Investigating Exhaled Air

1. Use the two boiling tubes, glass tubes in bungs and limewater to set up a piece of equipment where, if you breathe in and out gently, bubbles are drawn into one test-tube and bubbles pass out through the other test-tube as you breathe out.

   Draw the apparatus in its working form.

2. What do you observe about the two sets of limewater after you have breat through them for a short time?

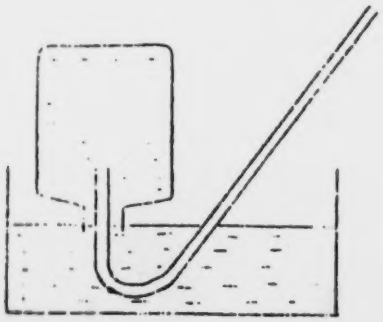
   .....

3. Use the measuring cylinder to add water to the large bottle and mark where each level comes until the bottle is full on one strip of tape. Write your name on that tape.

4. What is the total capacity of the bottle?

   .....

Invert the bottle into the sink of water and blow into the bottle until your lungs are empty.



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6. Record the quantity of air breathed out and repeat the experiment two more times.

Measurement 1 = cm^3

Measurement 2 = cm^3

Measurement 3 = cm^3

7. What was the average lung capacity?

.....

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2. An Investigation into Breathing

1. Breathe in and measure your chest = ... cms

   Breathe out and measure your chest = ... cms

   Work out your chest expansion = ... cms

2. Stand up and relax.

   Place your right hand flat on your tummy and the left hand flat on your lower left rib cage.

   (a) What happens to your tummy when you breathe out?

   .....

   (b) What happens to your rib cage when you breathe out?

   .....

   (c) What happens to your rib cage when you breathe in?

   .....

   (d) What happens to your tummy when you breathe in?

   .....

3. Relax, breathe out, and hold your nose, close your mouth, raise your rib cage, and release your nose as you do. Explain briefly what you notice.

   .....

   .....

4. Breathe out through the nose onto glass slide held up close to nose, three times. What do you notice on the glass?

   .....

5. Using the blue cobalt chloride paper provided, wipe the slide. What colour does it turn?

   .....

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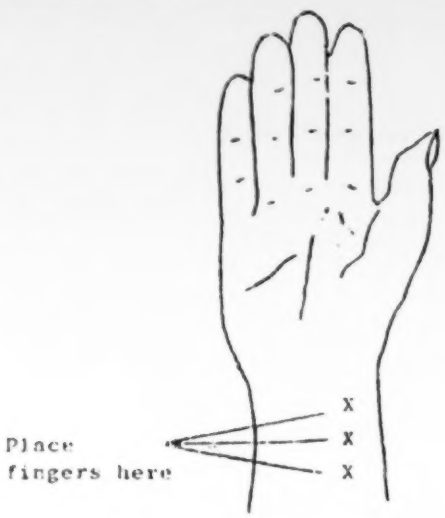
3. An Investigation into the Effect of Exercise on the Pulse Rate



This diagram shows where you should place the middle three fingers of your left hand to find the pulse in your right wrist.

Try it now. See if you can feel your pulse.

If you cannot feel anything, try moving your fingers about. If you still have trouble finding it, change your hands and try again.

1. Take your pulse in your wrist. Count the number of pulsations over a period of 30 seconds and make a note of it. Repeat twice more.

   Record your results here:

   1. .....

   2. .....

   3. .....

2. (a) Work out the average pulse rate.

   .....

   (b) What is your pulse rate per minute?

3. Take some form of exercise (as indicated by your teacher) for one minute.

4. Take your pulse rate as soon as you have finished the exercise and continue taking it every minute until it returns to normal. Record your results in the chart below.

MINUTES	PULSE RATE/MINUTE

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5. Record your results as a histogram (bar graph) on the graph paper provided.

6. How long does it take for your pulse rate to return to normal?

.....

7. Why does the heart beat increase during exercise?

.....

.....

.....

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4. Read the question carefully then carry out the instruction (a) to (e) without delay.

(a) Wrap the corrugated cardboard around the first of the three cups, holding it in position with an elastic band at the top and bottom; (cup 'a') Wrap the tissue paper around the second cup and secure it in similar fashion; (cup 'B'). The third cup is left as a control; (cup 'C').

(b) Thoroughly wet the tissue around cup 'B' using some of the hot water, then three-quarters fill each cup using the remaining hot water. Each cup should contain the same depth of water.

(c) Record the temperature of the water in each cup in the table below and repeat the readings after 4, 8, 12, and 16 minutes. Stir with the thermometer as each reading is taken and do not allow the tissue paper around cup 'B' to become dry.

(d) Plot your readings on the graph paper provided. The graphs for all three cups should be on the same axes but they should be distinguished by suitably different points and lines.

Time(min)	Cup 'A'(card)	Cup 'B'(tissue)	Cup 'C'(control)
0			
4			
8			
12			
16			

(e) (i) Which cup cooled least quickly?_____

(ii) Explain why this happened.

_____

_____

_____

(f) (i) Which cup cooled most quickly?_____

(ii) Explain why this happened

_____

_____

_____

(g) If the cups were left for several hours, what would be the final temperature of each of them?

_____

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(h) Explain how this experiment helps you to understand the ways in which mammals maintain a constant body temperature.

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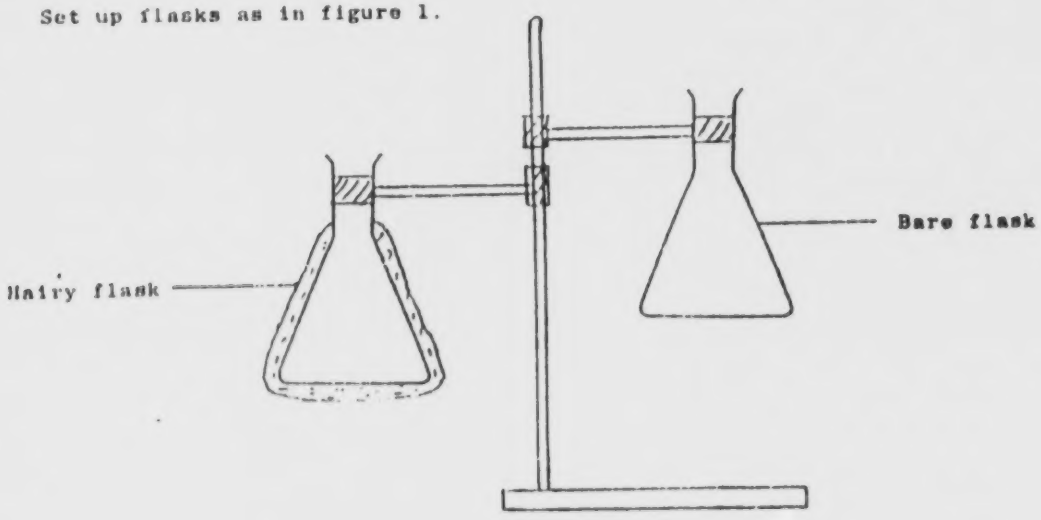
5. Investigation into the Skin of a Mammal and the Use of Hair in Temperature Control

Read the instructions carefully through at least once before starting this experiment.

Method

Set up flasks as in figure 1.



You are going to ask the teacher to fill your flasks with hot water, and then take the temperature of the water, by holding a thermometer in the water once every two minutes. The temperature of both flasks are entered in the form of a table in the space. Ten readings and the total temperature drop of the water in both flasks is required. Draw results table first in this space.

Results Table

Put your hand up when ready for hot water and show teacher your table

Plot results obtained in the form of a line graph on the graph paper provided, using x for the points of the hairy flask and O for the bare flask.

Graph to show temperature drop of water in two flasks of equal volume and surface area, one being bare and the other covered with hair.

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Answer the following questions using your results:

1. In which flask does the temperature of the water drop most after 20 minutes?

   .....

2. What improvement would you make to the apparatus, to slow down heat loss from the neck of the flask?

   .....

   .....

On the stage of the microscope is a slide of skin. Sketch the chief layers of the skin and one hair in as much detail as possible in the space below.

4. Do you think that the slide is of the skin of a very hairy or slighly hairy mammal? Give a reason for your answer.

   .....

   .....

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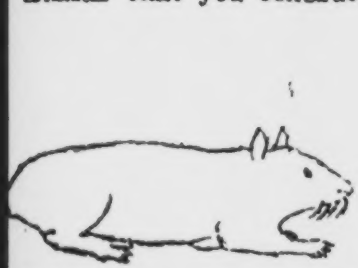
BONES

he two bones A and B come from the same side of a mammal. Identify A and B

_____

_____

On one of the animals sketched below, draw two lines, labelled A and B, to indicate the positions occupied by the two bones, choose the animal that you consider more appropriate for these bones.



Make a large drawing of the bones in side view as they would appear joined in the live resting animal(mammal). (no labels)

(a) Measure the length of A _____

(b) Measure the length of your drawing of A _____

(c) Calculate the magnification of your drawing _____

(a) Name the type of joint between A and B _____

(b) Name the type of joint found at the other end of A _____

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7. Eye Dissection

1. You are provided with an eye. Draw and label the front view of the eye in the space below:

2. Using the dissecting instruments provided remove the fatty tissue surrounding the eye so that the sclerotic cont, optic nerve and muscles attached to the eye are visible. Draw and label the eye from one side so that two muscle attachments and the optic nerve are visible.

3. Now make a vertical cut midway between the front and the back to separate the eye into its front and back halves. Remove the vitreous humour.

   In the space below draw and label the inside of the front half of the dissected eye.

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In the space below draw and label the inside of the rear half of the dissected eye.

What do you notice about the colour of the retina?

.....

.....

.....

PUT YOUR HAND UP. DO NOT CONTINUE UNTIL TOLD TO BY THE TEACHER.

Remove the lens, wash it and place on the watch glass for the teacher to see

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8. A Model Cat

Using the materials provided, carry out the following:

1. Add a small amount of iodine solution to a little starch on a clean white tile. Write down what you observe in the space below:

   .....

   .....

2. Take the piece of visking tubing supplied and measure its length.

   Length of tubing = ...

3. Soak the tubing in water until it softens and tie a knot in it as close as possible to one end. Leave it to one side.

4. Using a spatula place a small amount of starch powder into a test tube and half fill the tube with water. Shake the tube thoroughly to try to dissolve the starch. Does the starch dissolve?

   .....

   Describe the appearance of the contents of the test tube.

   .....

   .....

5. Using a pipette/syringe carefully place some starch solution inside the tube of visking tubing and add an equal amount of the glucose solution supplied. Take care not to drop any on the outside of the tubing. DO NOT OVERFILL. Now place the visking tubing inside a clean boiling tube and secure it there by folding the remaining length of visking over one side of the rim of the rim of the boiling tube, using an elastic band over the tube rim to hold the visking tubing in place.

6. Fill the test tube with water and add iodine solution to this water to colour it.

   Place the test tube in a rack and carry out the following:

   (a) Draw a diagram of the apparatus as you have set it up. Carefully label it and mark on your diagram the colour of the different solutions immediately the apparatus was set up.

PUT YOUR HAND UP FOR YOUR TEACHER TO INSPECT YOUR WORK.

(b) Draw a second diagram of the apparatus, after it has been set up for ten minutes, to show your results. Mark the colour of the various solutions.

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(c) Place the coloured end of the clinistix into the water surrounding the visking tubing. Record any colour changes of the clinistix. NOTE - Clinistix is a test for glucose.

.....

.....

(d) Knowing that the visking tubing is semi-permeable and using the information you observe from 1 and 6 (c) explain the results of your experiment.

.....

.....

.....

.....

PUT YOUR HAND UP. DO NOT TIDY AWAY UNTIL TOLD TO BY THE TEACHER.

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9. THE EFFECTS OF DIFFERENT SOLUTIONS ON POTATO TISSUES

1 Use a cork borer to cut four uniform cylinders of potato(or your) tissue. Trim all four to exactly the same length. They should be at least 5cm long and longer if possible.

2 Place one of each of the four cylinder in the following conditions:

i) immerse in water

ii) immerse in 5% sucrose solution

iii) immerse in 50% sucrose solution

iv) leave exposed to the air.

Leave the four cylinders for twenty-four hours.

3 At the end of this time remove the cylinders and measure their new lengths. Calculate the difference in length for each cylinder (+ or -) and the percentage change in length (+ or -).
Feel each cylinder and note whether its texture is firm or flaccid. Record all these results in the form of a table.

4 Discuss your observations and measurements for each of the four cylinders.

b) what other changes might be observed in the cylinders?

c) How could you extend this experiment to give more data?

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10.

YEAST AND OXYGEN

1 Fill a 100cm^3 beaker about $\frac{3}{4}$ full with warm water and add three spatula measures of yeast and one spatula measure of sugar. Stir well for a few minutes, until the yeast is fully mixed with the water. Add a few drops of methylene blue - enough to colour the yeast suspension pale blue. Mix well, label this beaker A.

2 Fill a second beaker about $\frac{3}{4}$ full with warm water only and add a few drops of methylene blue, as before. Label the beaker B.

3 Leave both beakers undisturbed for about 30 minutes.

NB Methylene blue is decolourised in conditions of low oxygen.

4 At the end of this time record the appearance of both beakers and explain your observations.

Table

Observations

5 Take the yeast suspension and pour it into an empty beaker and then back again. Do this two or three times. What do you observe in the solution? Try to explain your observations.

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6 In the light of your answers to (4) and (5) can you suggest why some fish cannot live in stagnant (stationary) water, but can only survive in fast-running water?

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11. Test for Starch in a Plant Leaf

1. You are provided with a fresh variegated leaf. Make a labelled drawing of the leaf in the space below:

PUT YOUR HAND UP FOR THE TEACHER TO CHECK YOUR WORK. DO NOT CONTINUE UNTIL TOLD TO.

2. What special features do you observe about the leaf?

.....

.....

.....

3. Carry out a starch test on the leaf as follows:

(a) Three quarters fill the beaker with water and heat it to boiling. Then boil the leaf in the water for 2 minutes.

(b) Turn out the bunsen burner (if you are using one).

(c) Remove the leaf with the forceps provided and place it into the boiling tube, which is one quarter filled with methylated spirits. Place the tube in the beaker of hot water to boil the methylated spirits.

(d) Boil for 10 minutes. (Do <u>not</u> light the bunsen burner.)

(e) Remove the boiling tube, take out the leaf. Using the forceps rinse the leaf in the hot water.

(f) Carefully spread the leaf out in a petri dish.

(g) What do you notice has happened to the leaf?

.....

.....

.....

PUT YOUR HAND UP FOR THE TEACHER TO CHECK YOUR WORK. DO NOT CONTINUE UNTIL TOLD TO.

(h) Add a few drops of iodine solution to the leaf. Gently rock the dish to spread the solution over the leaf. Leave it for a few minutes.

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4. Make a labelled drawing of the leaf in the space below:

5. What do you observe about the appearance of the leaf in section 1. when compared with that in section 4.?

.....

.....

.....

.....

PUT YOUR HAND UP FOR THE TEACHER TO CHECK YOUR WORK. DO NOT CLEAR AWAY UNTIL TOLD TO BY THE TEACHER.

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12.

TESTING URINE

1. Test the two urine samples for the following:

   (i) Chloride - add a few drops of nitric acid followed by $1cm^3$ of silver nitrate. A white precipitate indicates the presence of chloride ions.

   (ii) Ammonia - Add $1cm^3$ of sodium hydroxide (2M) and bring to boiling point. Hold a piece of damp red litmus in the mouth of the tube. Ammonia will turn it blue, if it is present.

   (iii) Protein

   (iv) reducing sugar.

2 Record your results in the form of a table. (You should record what you did, what you observed and what deductions you can make from your observations).

3 (a) Which urine sample came from a normal healthy person? Give reasons.

_____

_____

_____

(b) Explain your observations for the other sample.

_____

_____

_____

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The Effect of an Enzyme on Starch

13.

1. Label four test tubes A, B, C and D and put the solutions in as follows, mix well and note the time. Note also the appearance of each tube.

	A	B	C	D
Starch	5 cm^3	5 cm^3	5 cm^3	5 cm^3
Enzyme	1 cm^3	1 cm^3	1 cm^3	-
Boiled enzyme	-	-	-	1 cm^3
Dilute alkali	5 drops	-	-	-
Dilute acid	-	5 drops	-	-
Water	-	-	5 drops	5 drops

2. Test for starch, every two minutes, as follows:

Put four drops of iodine on your spotting tile and with a glass rod take out a drop of the liquid from each tube and separately add it to a drop of iodine solution on the spotting tile. Rinse the glass rod after each operation.

When there is no colour change on adding iodine, note the time taken and say what you have seen and from which tube the solution came.

Can you see any changes in the appearance of the contents of the test tubes since the experiment began? If so, describe them.

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3. Continue the testing with iodine on the tile for a while to see if there is any further change.

4. To find out what is produced from starch when acted on by an enzyme, boil a small amount of liquid from the tube which gives a yellow/brown colour with iodine, with an equal quantity of Benedicts reagent for two minutes. Leave it to settle and examine the precipitate.

Write what you see in the space below.

5. Tidy away when told to by the teacher.

6. (ii) What was put into the tube which cleared first?

.....

(iii) Which organ in the body is most likely to have similar conditions to those given in your answer to 6. (ii)?

.....

(iv) What do we call test tubes A, B and D?

.....

(v) Why were these set up?

.....

.....

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14. An Investigation into the Action of the Enzyme Pepsin on Egg White

The enzyme Pepsin acts on egg white (protein). The change from a cloudy suspension to a clear solution suggests that the egg white has been digested.

Using the materials provided, carry out the following:

1. Label four test tubes, A, B, C and D.

2. To each add 2 cm^3 of the egg white suspension.

3. Using a cleaned syringe put 2 cm^3 of pepsin in a test tube and boil in a waterbath over the Bunsen burner for 5 minutes. Take care.

4. To the four test tubes, add the following (cleaning the syringes where necessary):

   To test tube A add 1 cm^3 of pepsin solution

   To test tube B add 3 drops of dilute hydrochloric acid

   To test tube C add 1 cm^3 of pepsin solution and 3 drops of dilute hydrochloric acid

   To test tube D add 3 drops of acid and 1 cm^3 of boiled pepsin solution

5. Place the four test tubes in a waterbath at 35°C. After 20 minutes, compare the cloudiness of the four test tubes.

6. (i) Draw a chart/table and record your results:

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15. An investigation into the Action of the Enzyme Catalase

You are provided with cubes of different living tissue.

A. Take one cube of each tissue and place it in a separate test tube and add one inch of water. Label the tube A, B, C or D according to the tissue. Place the four test tubes in a beaker of boiling water and heat carefully for 15 minutes. Go on with section B.

B. In the spaces below describe very carefully the appearance of each of the fresh tissues.

Tissue A .....

Tissue B .....

Tissue C .....

Tissue D .....

C. Place one inch of hydrogen peroxide solution into each of four clean test tubes. Place one cube of tissue A into the first test tube and note carefully what happens. Write down your observations in the table below.

Now add a cube of tissue B to your second tube and write down your observations in the table. Continue with the other tissues and write down your observations in the spaces in the table.

TISSUE	REACTION WITH HYDROGEN PEROXIDE
A	
B	
C	
D	

D. CATALASE is an enzyme present in many living cells and it is able to break down hydrogen peroxide and release the gas oxygen. Which of the fresh tissues A to D do you consider contains the most catalase, and which do you think contains the least? Write down your answers in the space below and explain your choice.

Most catalase ..... reason .....

Least catalase ..... reason .....

E. Remove the four test tubes from the beaker of boiling water and pour the water down the sink. Place the pieces of boiled tissue onto a white tile taking care not to confuse the tissues by marking the tile. Describe the appearance of the tissues after boiling in the spaces below.

TISSUE	APPEARANCE AFTER BOILING IN WATER
A	
B	
C	
D	

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F. Now repeat section C of the experiment using boiled instead of fresh material. Write down your observations in the table below.

BOILED TISSUE	REACTION WITH HYDROGEN PEROXIDE
A	
B	
C	
D	

G. Using the information you have found out in this experiment - what effect would you say boiling has on the enzyme catalase? What information causes you to think this? Write your answer in the space below.

Effect of boiling on catalase is .....

.....

Information. .....

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ENERGY IN FOOD

16. You are provided with specimens of food labelled A and B. Read through the following instructions carefully before you start.

Carry out the following procedure with each specimen in turn

i) Place the specimen in the bottom of the small ignition tube.

ii) Heat the bottom of the tube strongly in a bunsen flame. Keep the test tube tilted slightly upwards.

iii) Observe the vapour which comes off first and condenses on the upper part of the tube - this is water.

iv) When smoke comes out of the tube, attempt to light it with a burning splint Remove the tube from the bunsen flame while you do this.

v) Repeat heating and lighting until no more smoke appear.

For each specimen complete the following table giving some indication of the relative amounts of water and smoke produced

	Colour of gases	Water	Smoke	Did it burn well, briefly or not at all?
A				
B				

a) How can you tell, from this experiment, whether a great deal of energy is being released?

b) Which specimen released the greater amount of energy?

c) In what form is most of the energy released in the above experiment?

d) When energy is released in the body, for what is it used?

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17.

You are going to ignite a peanut and use it to heat $20cm^3$ of water in a boiling tube. Place the thermometer in the water and leave it there. Record the temperature of the water.

Temperature of water _____

Spike the peanut (A) firmly on the mounted needle. Set fire to it by holding it in a bunsen flame and as soon as it is burning use it to heat the water in the boiling tube. (If it goes out, quickly reignite it). Let the peanut burn away completely until it will no longer relight.

Record the highest temperature reached by the water.

Final temperature of water _____

(a) For every $10^{\circ}C$ rise in temperature the water gains 0.8 kilojoules (kJ) of heat energy. This heat energy has been released by the burning peanut. Calculate the number of kilojoules gained by the water. Show your working. _____

_____

_____

_____

(b) A piece of peanut this size should release 5kJ of heat energy. Suggest reasons why your results differ from this value.

_____

_____

_____

(c) Suggest simple ways in which you could improve this experiment in order to obtain a more accurate result.

_____

_____

_____

(d) Take the whole peanut (B), cut it into small pieces and crush it (you can use the blunt end of the mounted needle). Carry out food tests using the reagents provided. Complete the following table.

NAME OF REAGENT	TREATMENT OF REAGENT	OBSERVATION	DEDUCTION

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(e) (i) From your results, which substance do you consider provided the greatest amount of energy to heat the water?

_____

(e) (ii) Give your reasons

_____

_____

_____

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18. Using a Key

(a) You are supplied with six different groups of plants labelled A to F and a key to help you to identify each specimen into its group. By use of the key fill in the names of the group AS GIVEN IN THE KEY of each specimen opposite the letter by which it is labelled and shown below. Show the steps you took in the appropriate place/column.

	Plant Name	Sequence of Steps in Key
A	.....	.....
B	.....	.....
C	.....	.....
D	.....	.....
E	.....	.....
F	.....	.....

(b) Draw specimen C, taking care not to shade or use colour. Give the magnification of your drawing.

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KEY

1	Plant without obvious root, stem or leaves	2
	Plant with stem, root and leaves	4
2	Either single celled or filamentous or seaweed	ALGA
	Not single celled, filamentous or seaweed	3
3	A colourless (without chlorophyll or other pigment) land plant	FUNGUS
	Dry, flattened encrusting plant, grey or green/yellowish to orange colour, brittle	LICHEN
4	Small land plant up to 8 cm in height; may bear capsules*	5
	If not as above	6
5	Definite stem bearing small spirally arranged leaves. Colourless or brown rhizoids* growing from base of stem	MOSS
	Flattened, lobed green thallus* which bears rhizoids on the underside	LIVERWORT
6	Green plant with fronds, may bear sori with spores on the underside. No flower present	FERN
	Plant with leaves, stems, flowers, fruits or cones	7
7	Plant with naked seeds borne in cones	GYMNOSPERM
	Plant with obvious flowers, seeds borne in fruits	8
8	Plant with narrow leaves, veins parallel; petals and sepals in threes or multiples of three	MONOCOTYLEDON
	Plant with broad leaves, network of veins; flower parts usually in four or five or multiples of four or five	DICOTYLEDON

*Glossary

Capsule	Spore bearing body
Rhizoid	Root-like filaments, hair-like structures for absorption from soil
Thallus	Plant body not differentiated into root, stem and leaf. Usually flattened lying close to the ground.

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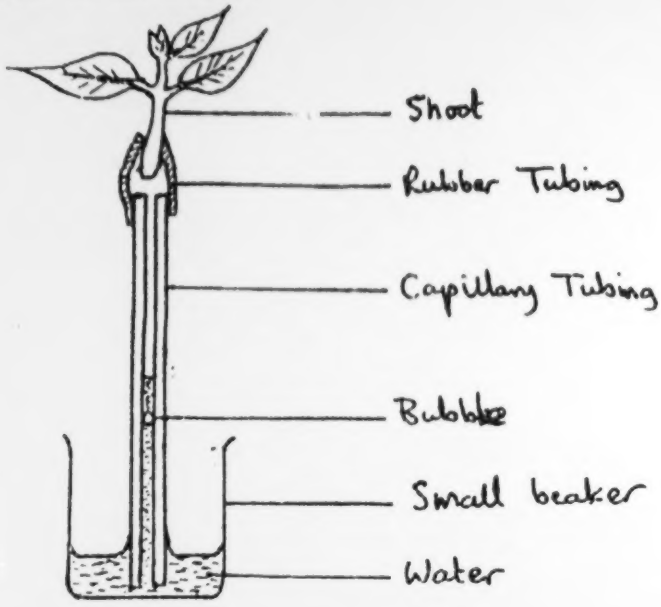
19. Your teacher will show you how to set up your potometer in a sink of water Hold the shoot in your hand or in a clamp so that the end of the capillary tubing is under the water in the beaker.

A Simple Potometer



Lift the potometer out of the water for a few seconds until a bubble of air enters the capillary tubing. Then re-immerse the tubing and watch the bubble rise. When it reaches the first mark on the tubing start timing, until it reaches the second mark. It has now travelled 10cm. Record the time.

Remove the bubble by squeezing the rubber tubing gently until the bubble has been forced out of the capillary tubing. Allow another bubble to enter, as before, and time again. Repeat this measurement several times. Calculate the average time taken for the bubble to move 10cm.

Results	Measurement no.	Time taken
	1	
	2	
	3	
	4	
	5	

Average =

The bubble moves along the capillary tubing as the shoot absorbs water. We can assume that the rate of absorption of water equals the rate of transpiration.

(a) Suggest possible reasons why the time taken for the bubble to move from 10cm was not exactly the same each time.

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(b) Suggest an advantage of the capillary tubing having a very narrow bore.

Now place the shoot potometer in different environmental conditioning as instructed by your teacher. (Eg. place a polythene bag over the shoot, or move the potometer to a windy spot outside). Leave it for a few minutes to adjust to the new conditions and then take a new set of readings, as before. Calculate the average.

Measurement no.	Time taken
1	
2	
3	
4	
5	
6	

Average =

(c) If your average is different from that of the first set of readings suggest possible reasons for this. There may be several reasons so include all sensible possiblities. If your readings are the same or very similar, again, try to explain this.

(d) List the same ways in which this experiment could be improved to give more reliable results.

20.

Take three clean test tubes fitted with bungs and add $2cm^3$ of bicarbonate indicator to each tube. (Do not breathe over the tubes indicator).

Label the tubes A, B and C.

Into tubes A and B place a broad-bladed leaf above the indicator- the leaf should not touch the indicator. Tube C is left empty. Replace all three bungs tightly. Cover tube B with black paper, using tape or elastic bands. Leave tubes A and C uncovered.

Note the colour of the indicator in each tube and record your observation. Place the tubes in strong light (sunlight or artificial light) and leave them for a few hours. At the end of this time note the colour of the indicator in each tube.

Record your observations in the form of a table. The table should include the treatment of each tube, the colour at the beginning and the colour at the end.

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a) Bicarbonate [illegible] is red/purple in conditions of low Co_2 and yellow in the presence [illegible] Co_2.
Discuss possible reasons for colour changes in any of the three test tubes.

b) What is the importance of setting up tube C without a leaf?

c) What result would you expect if you had set up a fourth tube, D, with a leaf and with mosquito netting on the outside? Give reasons.

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21. FLOWER STRUCTURE

a) (i) Remove a stamen from the flower and make a fully labelled drawing.
(ii) Remove the complete carpel and make a fully labelled drawing.

DIAGRAM (i)

DIAGRAM (ii)

For each drawing write down the largest dimension and use this measurement to calculate the magnification.

b) What functions performed by the stamen?

c) What do you think is the agent of pollination? Give your reasons.

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22. SEED DISPERSAL

1 Examine carefully specimens A,B, and C. Make a labelled drawing of each and indicate the magnification of each drawing.

SPECIMEN A

SPECIMEN B

SPECIMEN C

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2 From your observations, what do you consider is the most probable method of dispersal of each specimen? Give reasons in each case.

A Method (agent) _____

Reasons _____

_____

_____

_____

B Method/Agent _____

Reasons _____

_____

_____

_____

C Method/Agent _____

Reasons _____

_____

_____

_____

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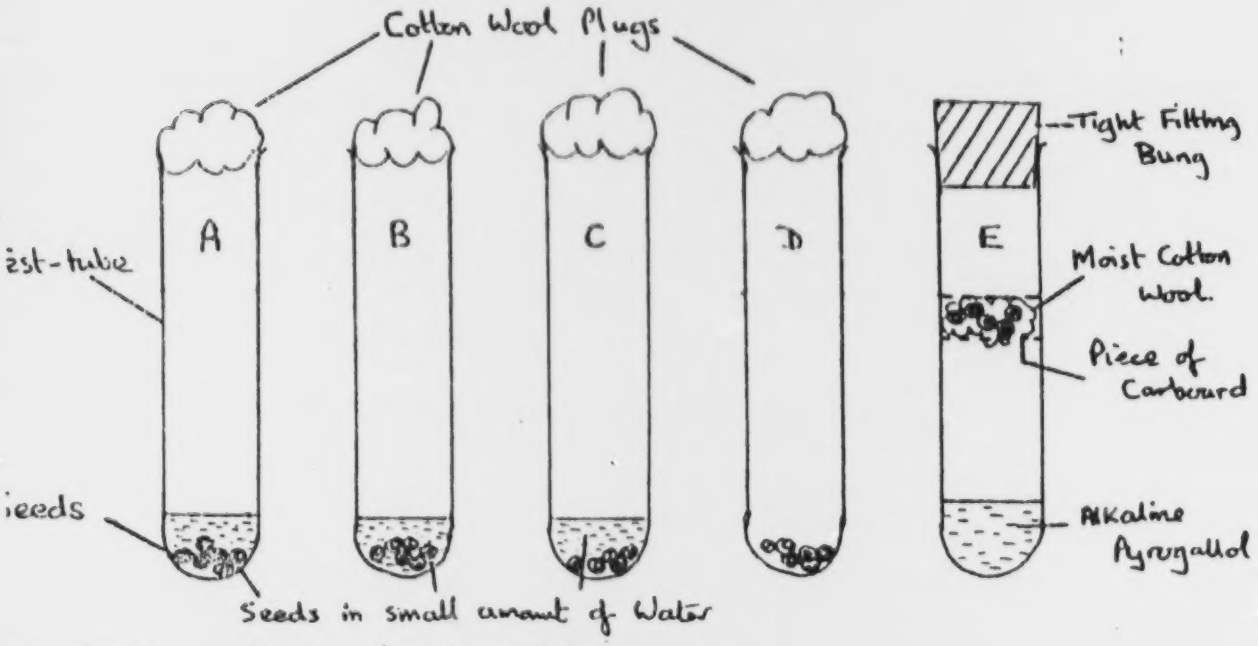
2.3. THE CONDITIONS FOR GERMINATION

1. Set up five test tubes as in the diagram below. Label them A to E.



Do not use more than 5 or 6 seeds per tube.

(Use only a little cotton wool per tube - otherwise you will find it difficult to get it out again.

TUBE E. Use a pipette to place about $2cm^3$ of pyrogallol in the bottom of the tube. Immediately push down the cotton wool, wet it and place the seeds on top. The bung must be tightly fitting. Pyrogallol absorbs the oxygen in the tube and it is essential that this operation is done quickly, before the pyrogallol becomes saturated with oxygen.

(WARNING: pyrogallol is poisonous and extremly caustic; it must not come into contact with the seeds or the cotton wool. If any touches you or your clothes wash it off with plenty of water.

2 Place the tubes in the following conditions;
A, D and E in a well-lit spot in the laboratory.
B in a dark cupboard
C in a refrigerator.

3 Examine the seeds after one, two and four days and note carefully their appearance.

4 Record all your observations in the form of a table. For each tube the table should state; the conditions which were present) out of light, water, warmth and oxygen) and the appearance after 1, 2 and 4 days.

NB. Recording 'no change' as an observation will not suffice - you must record their appearance.

5 Explain all your observations for each tube.

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GERMINATION

24.

Specimens A and B were planted at the same time and grown for the same period of time.

(a) Make a labelled drawing of each specimen, drawing each specimen to the same magnificatio. Indicate the magnification you have used.

SPECIMEN A

SPECIMEN B

(b) Measure the following:

length of the main stem _____ cms

length of main root _____ cms

distance between two nodes. _____ cms

Record these results in the form of a table together with any other differences you notice between the two specimens.

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(c) Suggest possible reasons for the differences you observe.

(d) What is the name of the condition exhibited by B?

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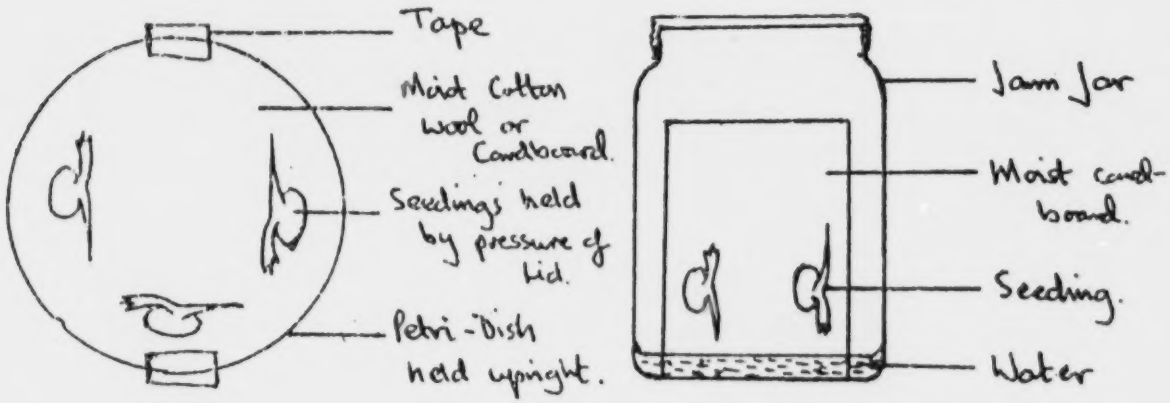
25. GEOTROPISM

1. Your teacher will provide you with three seedlings which have been germinating for a few days. Make sure you know which part is the plumule and which is the radicle, and then set up the seedlings so that one is upright, one is upside down and one is on its side. Use one of the two methods shown in the diagram.



2 Examine the seedlings every day for three dr four days and record all your observations. Ensure that the apparatus remains moist.

3 What use to the plant are the responses you have observed

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26.

a) Draw the cut surface of A (no labels required, but state magnification)

b) i What part of the plant is A?

ii Give your reasons_____

C) Take a small piece of tissue from each of A and B, chop and crush each and then shake the squahed pilp with enough water to half full a test tube. Divide the contents of each test tube between two further test tubes and test both for the presence of starch and reducing sugar. Record your results below.

		METHOD	OBSERVATION	DEDUCTION
A	Reducing Sugar			
	Starch			
A	Reducing sugar			
	Starch			

d) How do your results support your knowledge of the part played by A and B in the life history of their respective parent plants?

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27. Investigation Blowfly Larvae

You are to investigate the reactions of blowfly larvae under certain conditions. Follow the instructions given carefully and write your answers to questions in the spaces provided.

1. Take the beaker/dish marked A and using the black paper, sellotape and scissors, cover the outside of the beaker/dish to exclude light. Leave sufficient paper to form a lid. Leave beaker B for the time being.

2. DAMPEN the sawdust and place sufficient in EACH beaker/dish so that the surface of the sawdust is about 2 cm from the top of the beaker/dish.

3. You now have a dark and light dampened sawdust chamber. Take the blowfly larvae and place 8 of them in chamber B on top of the sawdust and the other 8 in the dark chamber A, placing the piece of black paper you left as a lid over the top.

4. Leave for ONE minute, then quickly count the number of larvae on the surface of the sawdust in EACH beaker/dish, taking care to replace the lid of the beaker/dish A very quickly.

   Repeat this procedure each minute until you have completed TEN observations (including the number at the start). Record your results in the space below:

5. From your OWN EXPERIMENT what conclusion can you draw about the behaviour of blowfly larvae exposed to light?

.....

.....

.....

6. LEAVE EQUIPMENT AND PAPER ON WORK BENCH

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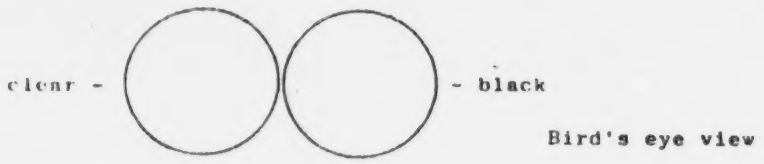
1. Put lower halves of [illegible] dishes together, one side black and one clear as in figure I.

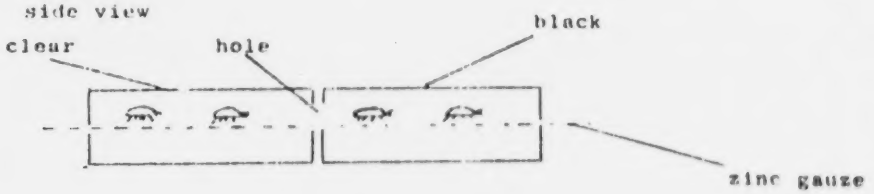
Figure I



Bird's eye view

Cover with mesh and place 4 woodlice on each side, cover with tops, holes together, as in figure II.

Figure II
side view



Record the number of woodlice in each dish at 2 minute intervals over 10 minutes. Construct a table of the results.

Put up hand, do not continue until checked by teacher.

2. Use same method but with clear dishes on both sides, placing water in the lower half on one side. Record as before for 10 minutes. Draw a table to record your results.

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When finished, put up hand, do not continue until checked by teacher.

29.

SOIL ANALYSIS

1 Fill a beaker or glass jar about ½ full with soil and then add water until it is about ¾ full. Stir vigorously for about 30 seconds, making sure that any lumps of soil are broken up.

2 Leave the soil to settle on the bottom. Watch carefully and record <u>everything</u> you observe during the first one or two minutes.

_____

_____

_____

_____

_____

3 Observe your soil sample again at the end of the lesson. (or within an hour or two of setting it up). Record its appearance again, stressing any differences between its appearance now and when you first left it to settle.

Make your final observation not sooner than one day later, again noting any changes you observe.

Make a large and fully-labelled drawing of your sample

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What conclusions do you draw from the results?

.....

.....

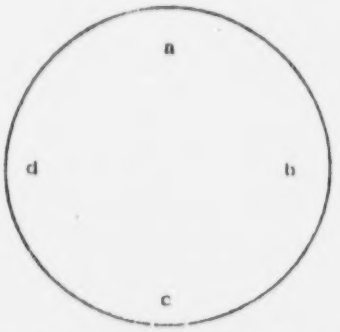
.....

3. Arrange around the edge of a plate, four kinds of food:

(a) flour, (b) moist dead leaves, (c) liver, (d) green grass

as in figure III.

Figure III



Put 4 woodlice in the centre, cover and leave for 10 minutes. Locate the positions of the woodlice and record your results.

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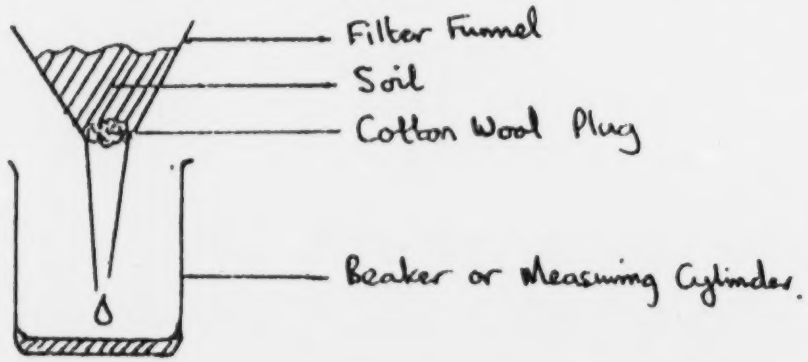
DRAINAGE AND WATER RETENTION

Set up the apparatus as in the diagram, one set for each type of soil.



2 Pour 50cm^3 of water on to each soil and leave it to drain through. Observe how quickly the water drains.

Measure the quantity of water which drains through and calculate the volume of water retained by each soil.

Which soil has the best drainage? Explain this result.

Which soil retains the most water? Explain this result

Which soil drains most slowly? Explain this result

Humus causes sandy soils to retain more water but it causes clay soils to drain more quickly. Why is this an advantage?

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6 Measure the depth of each soil fraction and use these figures to estimate the percentage of each type of soil particle in your sample.

7 Explain why the soil separates out into separate fractions in this experiment.

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SECTION C

APPARATUS REQUIREMENTS AND MARK SHEETS

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No. 1 Investigating Exhaled Air

Apparatus

2 boiling tubes

lime water

5 litre plastic squash contain with vertical strip of masking tape

1 x 250cm^3 measuring cyclinder

1m rubber tubing

1 test tube rack to take boiling tubes

access to sink and cold water tap

sterlising liquid (e.g. dettol)

Marking Scheme

Objectives to be assessed:

a) Manipulation
b) Drawing
c) Observation
d) Recording
e) Work habits/Respirations

a) Manipulation:	Boiling tube experiment set up correctly	0-4
	Setting up container for part 5	0-4
	Measurement of exhaled volume	0-2
		0-10
b) Drawing:	Diagram a reasonable representation of the apparatus	0-2
	Labelling of diagram	0-4
		0-6
c) Observation:	Colour change in lime water observed correctly	0-2
d) Recording:	Recorded total - capacity reasonable accurate	0-2
	Measurement reading for capacity	0-3
	Average lung capacity	0-1
		0-6

Work habits/Responsibilities:

Did students sterlise mouth-piece	0-2
Experiment carried out without accident and without much spillage	0-2
	0-4

Total 28

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No. 2 An Investigation into Breathing

Apparatus:

Tape measure (1 or 1½ metres long)

Glass slide

Blue cobalt chloride paper in a sealed tube

Marking Scheme

Objectives to be assessed: a) Manipulation
b) Observation
c) Reporting
d) Interpretation

a) Manipulation:	Tape measure placed around chest in sensible way to get measurement	0-4
b) Observation:	Correct observations as to the movement of rib cage and abdomen	0-4
c) Reporting:	For 3 and 4 Accurate assessment of what is happending	0-4
	Results of chest measurements plus calculation of chest expansion	0-4
		0-8
d) Interpretation:	The use of cobalt chloride paper as a test for water (vapour?)	0-2
	Total	0-18

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No. 3 The effect of Excercise on the pulse rate

Apparatus

Stop clocks or similar
Graph paper

Marking Scheme

Objectives to be assessed: a) Manipulation
b) Recording

a) Manipulation:	1 Pulse taken correctly	0-2
	2 Pulse taken with minimal delay after exercise	0 2 / 0-4
b) Recording:	Pulse taken three times/ results recorded	0-2
	Series of pulse rates recorded in table	0-1
	Reasonable results i.e fall in pulse rate	0-1
	Graph with little ad axes labelled, neat and with good comparison	0-8 / 0-12
c) Interpretation:	Conclusion drawn from graph	
	6. results	0-2
	7. Explanation	0-2 / 0-4

Total 20

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No. 4 Temperature Regulation

Apparatus

3 plastic cups per person
Corrugated cardboard (or similar) 1 piece per person
Tissue/toilet paper
Elastic bands
Thermometer (0-110°C)
Hot water (approx. 70°C)
Graph Paper

Marking Scheme

N.B. Manipulation: This practical offers plenty of scope for assessing students ability to organise equipment and take a series of readings with minimum of fuss and time wastage. Look for points such as: setting up the three cups.
Quickly and before they pour out any water; being ready to start timing and recording temperatures immediately the water is poured; keeping the tissue paper wet; how long the whole practical takes.

Objectives to be tested:
a) Manipulation
b) Recording
c) Interpretation

a) Manipulation:	Use of Thermometer	0-4
	Use of Timer/clock	0-4
	Setting up of Apparatus	0-8
b) Recording:	Accuracy and clarity of results	0-6
	Graph	0-8
c) Interpretation:	From the results	0-8
	Total	38

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No. 5 The Use of Hair in Temperature Control

Apparatus

1 x flask (round bottomed or conical)

1 x flask of same size covered ½" with hair
(sheeps wool or rabbits hair, cotton wool if hard up)

1 x stirring thermometer

hot water for both flasks at 70 - 80°C

Retort stand + 2 clamps

1 x microscope set up with slide of skin showing good hair detail

q x stop clock or watch or view of clock

1 piece of graph paper

Marking Scheme

Objectives to be assessed: a) Manipulation
b) Recording
C) Drawing
d) Interpretation

a)	Manipulation:	Apparatus set up in correct manner without help	0-4
		Use of thermometer	0-4
			0-8
b)	Recording:	Results table clearly done, with units etc.	0-6
		Graph axes done correctly and fully labelled	0-8
			0-14
c)	Drawing:	Good sketch of skin and hair supplied	0-8
d)	Interpretation:	Correct assumption on slide provided with reasonable explanation e.g. lot of hairs seen	0-2
		Total	32

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No. 6 Bones

Apparatus

Each student will require the humerus, radius, and ulna of a small mammal (rat, rabbit or cat)

Rulers (cms.)

Plain paper (for section 3)

Marking Scheme

Objectives to be assessed: a) Manipulation
b) Observation
c) Work habits/Responsibility
d) Interpretation

a) Manipulation:	Measurement of bones to calculate magnification	0-2
b) Observation:	Observing relevant features for identification of bones (help needed?)	0-4
c) Work habits/ Responsibility:	Care and careful use of specimens	0-4
d) Interpretation:	Marking the positions of bones (1 for correct animal (1 for correct line (2 for correct position)	0-4
	Calculation of magnification	0-2
	Names of joints	0-2
		0-8

Total 18

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No. 7 Eye Dessection

Apparatus

Eyeball

Dissecting instruments

Dissecting board (wood or wax)

Watch glass

Marking Scheme

Objectives to be assessed: a) Drawing
b) Manipulation
c) Observation
d) Work habits/Responsibility

a) Drawing: i) Front of eye resembles specimen with good representation of parts (part 1) 0-

ii) Inside of the front half resembles specimen reasonably well (part 3) 0-

Drawing of the inside near half resembles specimen 0-

0-10

b) Manipulation: Dissection in 2 is satisfactory (i.e. not 'butchered'). Optic nerve, muscle and sclerotic coat left intact 0-8

Dissection in 3 is satisfactory 0-4

0-1

c) Observation: Lens correctly identified 0-2

Clarity of observation in the identification of optic nerve, muscle and sclerotic coat. (Is help needed by teacher?) 0-2

d) Work habits/ Responsibility: Careful use of dissection instruments

Care taken over the cleaning of materials, work surfaces and washing of hands

N.B.: (Great care must be taken about hygene when dissecting any biological material in the laboratory). 0-

Total

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No. 8 A Model Cat

Apparatus

Visking tubing
Boiling tube and rack
Rubber bands
syringe/pipettes
Iodine solution
White tile
Insoluble starch powder
1% starch solution
Further beaker containing glucose solution (5%), labelled
Spatula

Marking Scheme

Objectives to be assessed: a) Manipulation
b) Observation
c) Drawing
d) Interpretation

a) Manipulation:	Testing for starch	0-4
	Measuring the Visking tubing	0-2
	Boiling tube containing visking tubing and starch correctly set up	0-2
		0-8
b) Observation:	Starch completely dissolved	0-1
	Description of starch suspension	0-2
	Correct observation of colour change shown on drawing	0-1
		0-4
c) Drawing:	Clear accurate representation of apparatus set up in both diagrams	0-8
	Labelling of drawings	0-4
		0-12
d) Interpretation:	Explanation of results of experiment	0-2
	Total	26

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No. 9 The effects of Different solutions on Potato Tissues

Apparatus

English potatoes (sweet potato, yams etc.will also work)
Cork borers (or cut potato with knife into rectangles)
Beakers
Sucrose solutions: 5% and 50% (or use salt)

Marking Scheme

Objectives to be assessed: a) Manipulation
b) Planning and design
c) Recording
d) Interpretation

a) Manipulation: Preparation of potato cylinders. Uniform size, use of cork borers 0-2

Trimming and measurement of cylinders Use of ruler, scapel etc. 0-4

Selection of best cylinders for experiment 0-2

0-8

b) Planning and Design: Correct selection and use of apparatus to carry out expt. 0-4

Extension of experiment Question 4c) to provide more data 0-2

0-6

c) Recording: Design of table: properly set out with all details present e.g conditions, Initial length (mm), final length (mm), difference in length, % change, texture 0-4

Correct calculations (% change) 0-4

Clarity of observations 0-2

0-10

d) Interpretation: Questions:
4 (a) Increase in mass due to absorption of water by osmosis 0-3

Decrease in length due to osmosis cames cells to become flaccid 0-3

Lost of water by iv) due to evaporation, hence decrease in length 0-2

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d)	Interpretation cont'd:	b) Loss/gain in mass	0-2
		c) Use several cylinders in each beaker and take average	0-2
		Use several solutions over the range 5% - 50%	0-2
			0-14
		Total	38

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No. 10 Yeast and Oxygen

Apparatus

Dried yeast
sugar
Methylene blue
Warm water (30 to 40°C)
Beakers (Glass jars)
Spatulas

Marking Scheme

Objectives to be assessed: a) Observation
b) Recording
c) Interpretation

a) Observation:	From the table	
	Beaker A - Pale Brown colour	0-1
	Beaker B - Pale Blue colour (remains the same	0-1
	Beaker A - (After aeration) Blue colour returns	0-1
	Beaker A - Thin blue layer to top	0-1
		0-4
b) Recording:	Neat, clear recording and accurate results	0-2
c) Interpretation:	Questions:	
	4) Decolourisation of methylene blue due to respouration of yeast.	0-2
	Blue layer due to O_2 dissolving in top layer of water	0-2
	Beaker B remains pale due to absence of yeast, O_2 not removed.	0-2
	5) Blue colour returns due to aeration of liquid.	0-2
	6) More O_2 dissolves in running water	0-2
		0-10
	Total	16

No. 11 Testing for Starch in a leaf

Apparatus:

Fresh variegated leaf, e.g. Tradescantia, Geranium, removed from a plant in a well lit position

Large beaker (at least $400cm^3$)

Boiling tube and rack

Industrial methylated spirits

Means of boiling the beaker

Forceps

Solution of iodine in postassium iodine labelled: 'Iodine solution'

Petri dish

Hand lens

Marking Scheme

Objectives to be assessed:
a) Drawing
b) Observation
c) Manipulation
d) Work habits/Responsibilities
d) Interpretation

a)	Drawing:	Clear accurate representation of variegated leaf in 1	0-6
		Clear accurate representation of variegated leaf in 4	0-4
			0-10
b)	Observations:	Valid observations recorded in 2 veins, venation pattern etc.	0-3
c)	Manipulation:	No trace of green present in leaf as indication of efficiency of student	
		Carrying out chlorophyll extraction	0-4
		Carrying out of Food tests (see Expt 26)	0-4
d)	Work Habits/ Responsibilities:	Careful use of methylated spirits for chlorophyl extraction (can be dangerous)	0-2
		Tidy work bench, cleared properly	0-2
		Careful use of Bunsen Burner throughout experiment	0-1
			0-5
e)	Interpretation:	Explanation of chlorophyll extraction (3(g)	0-2
		Explanation of starch test on leaf (5) and results	0-2
			0-4
			Total 30

No. 12 Testing Urine

Apparatus

Dilute nitric acid

Silver nitrate solution (0.01M)

Sodium hydroxide solution (2M)

Sodium hydroxide solution)
Copper sulphate solution) Food test

Benedicts solution

Urine (labelled A) with little glucose added

Urine (labelled B)

Red litmus paper

Heating apparatus

Test tubes

Test tube holders

Measuring cylinders (0-10cm^3)

Access to water and sink

Test tube rack

Marking Scheme

Objectives to be assessed:
a) Manipulation
b) Recording
c) Work habits/Responsibility
d) Interpretation

a)	Manipulation:	Setting up the apparatus as required	0-4
		Performing the chloride and ammonia tests (organisation of time etc.)	0-8
		Performing food tests correctly	0-8
			0-20
b)	Recording:	Design andpresentation of results	0-6
c)	Work habits/ Responsibilities:	Careful and economic use of chemicals	0-4
d)	Interpretation:	Deductions and conclusions from results to answer questions 3(a), (b)	0-6
		Total	36

No. 13 The effect of an Enzyme on Starch

Apparatus

2% starch solution W.V.

Fresh Diastase solution (W.V. concentration adjusted to produce an end point in about 10 minutes) - about 1% should be adequate

Boiled diastase solution

5 test tubes per pupil

Glass rods

Dilute acid (0.5m)

Dilute alkali (0.5m)

Spotting tile

Iodine solution

Benedict's solution

Boiling bath

3 syringes or graduated pipette

Marking Scheme

Objectives to be assessed:
a) Manipulation
b) Reporting
c) Observation
d) Interpretation

a)	Manipulation:	Correct setting up of tubes A, B, C and D (can be cross checked with results)	0-4
		Correct testing on spotting tile	0-2
			0-6
b)	Reporting:	Correct organisation and presentation of facts in the description required in part 2	0-4
c)	Observation:	Colour changes correct (2 and 3)	0-2
		Colour changes related to correct test tube	0-2
		Correct observation of changes in test tube	0-2
		Correct observations on continuation of spotting tile experiment	0-2
			0-8
d)	Interpretation:	Part 6	
		i) All conditions met	0-1
		ii) Correct assumption	0-1
		iii) Correct assumption	0-1
		iv) The use of controls	0-1
			0-4

Total 22

No. 14 The Action of pepsin on Egg White

Apparatus

Albumin or egg white suspension

Pepsin solution - adjusted to appropriate concentration to clear albumin in approximately 20 minutes (see (5))

Dilute HCi (bench) in stopper bottles or equivalent

Syringe - accurate at $1cm^3$ - can use a measuring cylinder

Test tube holder (or beaker)

Tongs or water bath for boiling pepsin

Bunsen burner

Chinagraph pencil

Water bath set at 35^oC

4 test tubes (per pupil)

Marking Scheme

Objectives to be assessed:
a) Work habits/Responsibilities
b) Planning/Design
c) Observation
d) Manipulation

a)	Work habits/ Responsibilities:	Labelling of test tubes in a suitable manner (considering immersion in water bath)	0-1
		Minimal contamination between tubes (Important if experiment are to be successful)	0-2
		Apparatus cleaned or left in specified condition	0-1
			0-4
b)	Planning and Design:	Suitable chart/table for presentation of results	0-6
c)	Observation:	Identification of differences between conditions of tubes after water bath	0-4
d)	Manipulation:	Test tubes A to D correctly set up (Cross. Check with results)	0-4
		Total	18

No. 15 The Action of the Enzyme Catalase

Apparatus

Cubes of fresh potato, apple, liver and kidney at room temperature
12 Test Tubes

Beakers

White tiles

Hydrogen peroxide (10 vols. should be diluted further if desired, 2 vols. strength should work)

China graph pencil

Timer

Marking Scheme

Objectives to be assessed:
a) Manipulation
b) Observation
c) Interpretation
d) Work habits

a)	Manipulation:	Preparation of test tubes carried out correctly	0-4
		Use of apparatus during the experiment	0-2
			0-6
b)	Observation:	Correct observations of amount of fizz for liver and potato	0-4
		Description of liver tissue after boiling	0-2
		Appearance of each fresh tissue	0-4
			0-10
c)	Interpretation:	Effect of boiling deactivitises enzyme	0-2
		Correct conclusions/reasons for D	0-2
			0-4
d)	Work habits/ Responsibility:	Careful use of/with tissues and chemicals	0-2
		Total	22

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No. 16 Energy in Food

Apparatus

Small cube of cheese (sides 0.5cm)
Small cube of meat (nam) (sides 0.5cm)
Ignition tubes
Heating apparatus
Test tube holder

Marking Scheme

Objectives to be assed:		Rating
Manipulation:	Preparation of cubes of food	0-4
	Use of Bunsen Burner with ignition tube	0-4
Observation:	Table:	
	a) If a lot of smoke is produced and this burns well, a lot of energy is being released	0-2
	b) A	0-1
	c) Heat	0-1
	d) Growth, movement, production of chemicals, nerve transmission etc.	0-4
Work habits and Responsibility:	a) Care when burning food (direction in which tube is pointing	0-1
	b) Care in placement of hot tubes after ignition of food	0-1
	c) Economic use of food samples	0 1
	d) Cleaning away of unused food sample and thorough washing of apparatus (Health risk)	0-1
	Total	27

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No. 17 Burning Peanuts

Apparatus:

One half peanut (a) } shelled:
One whole peanut (b) }

Boiling tube

Thermometer (0-110°C)

Clamp stand (test-tube holder)

Mounted needle

Reagents for food tests (starch, reducing sugar, fat)

Ignition source (bunsen Burner)

Scalple (or kitchen knife)

White tile

Marking Scheme

Objectives to be assessed:
a) Manipulation
b) Planning and Design
c) Recording
d) Interpretation

a)	Manipulation:	Setting up apparatus as directed	0-4
		Use of the thermometer	0-4
		Correct burning of the peanut and placing under boiling tube	0-4
		Carrying out of food test	0-8
			0-20
b)	Planning/Design:	Improvements to the experiment and apparatus	0-6
c)	Recording:	Quality of table and results	0 6
		Calculation	0-4
			0-10
d)	Interpretation:	Drawi conclusions from own results	0-4
			Total 40

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No. 18 Using a Key

Apparatus

Each candidate should be provided with six speciments, labelled A - F, of plants from different plant groups. All candidates of the same school should have more or less identical species where numbers permit and all specimens should be labelled either by use of ties or placing them in labelled receptacles. Labels A to F should be consistent within the same school.

Marking Scheme

Objectives to be assessed:
a) Drawing
b) Observation
c) Interpretation

a) Drawing:	See 'Flower structure' experiment for break down of objectives	0-12
b) Observation:	Correct identification of salient features of plant for use with key	0-8
c) Interpretation:	Plants A to F correctly names a d in sequence	0-12
	Total	32

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No. 19 Measuring the rate of Transpiration

Apparatus

Simple potometer or Darwin Potometer, or suitable alternative, set up with leafy twig (see Nuffield Year 3 Teacher's Guide p. 164 - 164 old edition. The candidates may set it up themselves, but setting up is not to be assessed

Visual access to a clock showing time of day

Means of timing in seconds

Tissue paper or alternative for blotting the capillary

Beaker

Fan heater or other source of warm moving air and any other artificial conditions required

Marking Scheme

Objectives to be assessed: a) Manipulation
b) Recording
c) Interpretation

a)	Manipulation:	Competence in setting up the potometer	0-8
		Ability to move apparatus without upsetting beaker etc.	0-2
			0-10
b)	Recording:	Quality of table of results (2)	0-8
c)	Interpretation:	a) Any sensible suggestions e.g. living material does not behave with complete uniformity/shoot had not had long enough to adjust to conditions/slight variations in conditions/timing not 100% accurate	0-3
		b) Bubble moves faster, so more readings can be taken	0-3
		c) Answers will depend on what conditions were used. Look for answers which explore more than one possibility. e.g. outside the laboratory, the shoot could be affected by sunlight and by wind. N.B. A cut shoot may well not behave exactly as would a whole plant.	0-3
		d) Take more readings over longer period of time/allow the plant longer to adjust. Repeat with several specimens/pool the class results/try several different environmental conditions/try other species of plant etc.	0-3
			Total 30

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No. 20 Gaseous Exchange in leaves

Apparatus

Test tubes

Bungs

Chinagraph Pencil

Bicarbonate indicator

Measuring cylinder

Black paper (newspaper)

Elastic band (tape)

Test tube rack

Broad bladed leaf

Marking Scheme

Objectives to be assessed:

Manipulation:	Measuring out accurate quantities of Bicarbonate indicator	0-2
	Preparation of test tubes following instructions (B must be light-tight)	0-2
		0-4
Observation:	Table: Correct colour of Indicator before and after experiment	0-4
	Correct treatment of tubes	0-4
	Neat, clear recording and accurate results	0-2
		0-10
Interpretation:	Questions: a) Leaf photosynthesising in presence of light, therefore removing CO_2 from air in the tube which causes colour change	0-3
	b) Cannot photosynthesise in dark but respiration continues..... it gives out CO_2 and indicator turns yellow	0-2
	c) It would turn the indicator orange or red but less than A. Light is available but it is reduced so photosynthesis too is reduced and less CO_2 is taken up	0-3
		0-8
Work habits/ Responsibility:	Willingness to return to lab, second results and clear up after experiment	0-2
		Total 24

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No. 21 Flower Structure

Apparatus

Flower - (with single, easily removed carpels and stamens)
Handlens (x5 or x10)
Plain paper

Marking Scheme

Objectives to be assessed: a) Drawing
b) Interpretation
c) Environmental Awareness

a) Drawing:	i)	Accuracy of labelling	0-2
	ii)	Suitable size of drawing (large and clear	0-2
	iii)	Accurate representation	0-2
	iv)	Good drawing technique, using clean and continuous lines	0-2
	v)	Free from shading	0-1
	vi)	Correct Magnification (2 x 2)	0-4
	vii)	General presentation	0-1
	viii)	Labelling	0-14

b) Interpretation:	Questions:		
	b)	To produce and release pollen	0-1
	c)	Insects	0-1
		Large flower, coloured petals, non-feathery stigma, stamens inside flower, scent	0-4
			0-6

c) Environmental Awareness:	a)	selection of flowers (by students) from a suitable source. (Bringing single flower etc.	0-2

Total 22

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No. 22 Seed Dispersal

Apparatus

See dispersed by deluiscence (explosion) (a)
Wind dispersed seed or fruit (b)
Animal dispersed seed or fruit (c)
Hand lens (x5 or x10)
Plain paper

Marking Scheme

Objectives to be assessed: a) Drawing
b) Observation

a). Drawing:	i)	Accuracy of labelling (3 x 0-1)	0-3
	ii)	Suitable size of drawing (large and clear) (3 x 0-1)	0-3
	iii)	Accurate representation (3 x 0-2)	0-6
	iv)	Good drawing technique, using clean and continuous lines (3 x 0-2)	0-6
	v)	Correct magnification (3 x 0-2)	0-6
	vi)	Free from shacking	0-1
	vii)	Labelling 3 x 0-2)	0-6
	viii)	General Presentation	0-1 / 0-32
b) Observation:	Questions (from observations)		
	A - Wind dispersed and reason		0-4
	B - Animal dispersed and reason		0-4
	C - Deluiscence and reason (1 for correct method), 3 for correct reason)		0-4 / 0-12
		Total	44

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No. 23 The Conditions for Germination

Apparatus

Boiling tubes (or test tubes)

Cotton wool

Bungs

Seeds (cress is the best - short germination time, but others will work well, only longer time scale).

Pyrogallol (preparation - Soper & Smith p.13)

Test tube rack

Chinagraph pencils

Access to refrigerator

Marking Scheme

Objectives to be assessed:
a) Manipulation
b) Observations
c) Work habits/Responsibility
d) Interpretation

a)	Manipulation:	Setting up 5 test tubes as shown in diagram	0-5
b)	Observation:	Well throughout, accurate observations (in the table of results	0-10
c)	Work habits/ Responsibility:	Economic use of materials (in seeds, cotton wool)	0-1
		Care with the use of pyrogallol	0-2
		Persistance of student to continue with experiment over a prolonged period of time	0-4
d)	Interpretation:	Explanation of observations	0-8
		(See Table Below)	Total 30

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Tube	Conditions	Day 1	Day 2	Day 4
A	Light, water warmth, oxygen	Seeds, wet and swollen(radicle may have burst through testa)	Plumule appeared. Height only a few mm. Root hairs	Shoot 2-4 cm green leaves white stem. Longer roots, many root hairs
B	Water, warmth oxygen	As for A	As for A (though the plumule in A may be green - not in B	Shoot taller than A. Leaves small and yellow. Roots the same as A
C	Water, oxygen	Seeds wet and swollen	As for day 1	As for day 1, but radicle may appea if fridge is not very cold.
D	Light, warmth oxygen	Seeds remain dry.	As for day 1	As for day 1
E	Water, light warmth	Seeds wet and swollen	seeds wet and swollen	Seeds wet and swollen. Deduct marks if any sign of germination.

The differences between A and B on day 4 must be recorded. E must not germinate.
Deduct marks for inaccurate or incomplete observations, or poor setting out or table.

A - absorbs water, germinates successfully with warmth and oxygen. Leaves produce chlorophyll in light.

B - as for A but leaves cannot produce chlorophyll in dark. Tall because seedlings trying to reach light.

C - seeds absorbs water but respiration tooslow in cold, therefore no (or little germination).

D - seeds cannot absorb water therefore no germination. Shows that wa is essential before germination can begin.

E - seeds absorb water without oxygen, therefore this is a purely physical process. No germination because no respiration.

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No. 24 Germination

Apparatus

Pea seeding (A) Germinated in light until at least two nodes are visible.

Pea seeding (B) Germinated in the dark for the same length of time

Plain paper

Marking Scheme

Objectives to be assessed: a) Drawing
b) Manipulation
c) Recording

a) Drawing:	i)	Looking for a sharp pencil line	0-1
	ii)	No shading of colouring in diagram	0-1
	iii)	Suitable size of drawing	0-1
	iv)	Correct magnification of specimens and drawing each to the same magnification (which to draw first?)	0-4
	v)	General presentation	0-1
			0-8
b) Manipulation:		Use of ruler to measure specimens	0-4
c) Recording:		Design and clarity of table	0-2
		Measurements calculations for table	0-2
		Differences between two specimens	0-2
			0-6
		Total	24

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No. 25 Geotropism

Apparatus

Germinating seeds (Black eye, French beans etc.) 2 to 3 days old, with radicle and plumule emerging.

Cotton wool

Stiff cardboard/paper

Petri dish

Screw top jar (the students can bring their own)

Pins

Masking tape

Marking Scheme

Objectives to be assessed:
a) Manipulation
b) Observation
c) Interpretation
d) Work habits & Responsibility
e) Report

a) Manipulation: Setting up of apparatus using one of the two methods shown (jam jar or petri dish) 0-4

Positioning of seeds as instructed 0-

Adequate moisture provided 0-1

0-5

b) Observations: Recorded in a clear concise manner (Mention should be made of tropic responses, increase in length, level of leaves, production of chlorophyll in leaves, growth of root hairs 0-

c) Interpretation: Usefulness of tropic responses in plants (question 3) 0-

d) Work habits/ Responsibilities: Students observing their seedlings every-day 0-

Students should look after their apparatus 0-1

Persist with experiment without supervision 0-2

Clean and use of apparatus 0-

0-

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No. 25 Cont'd

c) Report : Observations recorded for the duration of experiment should be present in chronological order with attention to detail (the 'Method') 0-4

N.B. Linked to observation Total 26

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No. 26 Stored Food

Apparatus

A. Half lime cut in transverse plane (must have seeds)
B. Piece of potato with at least one 'eye' visible.
Scapal or kitchen knife
White tile
Food test reagents (starch, reducing sugar)
Heating apparatus
Test tubes
Hand lens

Marking Scheme

Objectives to be assessed: a) Drawing
b) Manipulation
c) Interpretation
d) Work habits/Responsibility

a) Drawing:	To be large and clear	0-2
	To be made in pencil using clea continuous lines	0-2
	To be an accurate representation	0-2
	To be free from any shading	0-2
	Correct magnification	0-2
		0-10
b) Manipulation:	Reforming food test for starch in the correct manner	0-2
	Reforming food tests for reducing sugar in the correct manner	0-2
	Preparation of food for food tests	0-2
		0-6
c) Interpretation:	Questions:	
	(b) i) Fruit	0-1
	ii) Seeds enclosed by fleshy wall	0-1
	(c) Method 1 x 2	0-2
	Observation 1 x 4	0-4
	Deduction 1 x 4	0-4
	(d) A stores sugar to attract animals which will disperse seeds.	
	B. stores starch because it gives rise to new shoot by vegetative reproduction. Starch provides energy for this new growth	0-4
		0-16

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No. 26 Cont'd

d)	Work habits/Responsibility:	Care in the use of food test chemicals	0-2
		Economic use of materials	0-2
			0-4
		Total	36

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No. 22 Investigating Blowfly Larvae

Apparatus

Each candidate requires:-

16 Blowfly larvae

2 crystallising dishes or flat topped beakers

Quantity of dry sawdust

Sheet of black paper 30cm x 30cm, or black polythene

Scissors

Sellotape

Water available

Clock available

Marking Scheme

Objectives to be assessed: a) Manipulation
b) Planning and Design
c) Recording
d) Interpretation

a)	Manipulation:	Beaker A covered to exclude light	0-2
		Sawdust dampered efficiently	0-
		Sawdust correctly placed in containers	0-2
		Correct number of larvae in position	0-
			0-
b)	Planning/Design:	Good procedure for counting larvae	0-
c)	Recording:	Properly draw results table	0-4
	..	Table with TIME included	0-2
			0-
e)	Interpretation:	Reasonable conclusion according to results obtained and recorded	0-
			Total 22

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No. 28 Investigating Woodlice

4 petri dishes (1 blackened, 3 clear - with hole in one side of tops)

1 dinner plate or equivalent

16 woodlice

2 x zinc gauze to fit over 2 petri dishes side by side (alternatively use stiff muslin)

Water in beaker

4 kinds of food (a) flour, (b) dead moist leaves, (c) 1 square liver (d) green grass

Marking Scheme

Objectives to be assessed:- a) Manipulation
b) Interpretation
c) Planning and Design
d) Work habits and Responsibilities

a)	Manipulation:	Experiment I, II and III set up correctly	0-12
b)	Interpretation:	In 2 from results of 2	0-2
c)	Planning & Design:	Table of results for experiment I, II and III	0-12
d)	Work habits/ Responsibilities:	Handle woodlice carefully and sensibly	0-4
		Total	30

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No. 29 Soil Analysis

Apparatus

Soil sample (students bring their own - better range of results obtained)

Stirring rod (stick)

Gas jar/glass jar

Marking Scheme

Objectives to be assessed:
a) Drawing
b) Observation
c) Manipulation
d) Interpretation
e) Work habits & Responsibility

a) Drawing: Making a large, clear diagram of soil profile

Correct labelling of different layer. Labels Humus, water, clay, silt, sand, gravel

Accurate representation

b) Observation: Careful observation over a period of time identifying small changes that occur.

2) i) Sand/gravel particles settle immediately, followed by find sand/ silt, water very cloudy, humus of organic matter float.

3) ii) More silt settled, plus (possibly) a thin layer of paler clay. Water less cloudy. Lower layers unchanged, humus still floating, though some may have settled.

4) Water clear, or nearly so, thicker layer of clay settled, more humus settled, but not all

c) Manipulation: Use of ruler for measurement of approx. depths of fractions

d) Interpretation: Correct calculation of percentag s =

6) $\frac{\text{length of Fraction} \times 100}{\text{Total Length}}$

7) Because bigger particles are heavy and these settle first

e) Work habits/ Responsibilities: Students remember to bring soil samples to school on the correct day

Total

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No.30 Drainage and Water Retention

Apparatus

Filter funnel
Beaker
Cotton wool
Measuring cylinder (0-100cm^3)
Soil samples (sand and clay)
Clamp stand

Marking Scheme

Objectives to be assessed: a) Manipulation
b) Interpretation
c) Work habits & Responsibilities

a) Manipulation:	Setting up the apparatus as shown and directed	
	Adjustment of clamp stand	0-1
	Effectiveness of cotton wool plug	0-1
	Same amounts of soil in each funnel	0-1
	Making sure soil is free from lumps- (using sieve)	0-1
	Measurement of water with measuring- cylinder (Before adding to soil)	0-1
	Pouring of water evenly over the soil -sample	0-1
	Waiting till all, the water has drained through	0-1
	Measuring water collected	0-1
	Timing, correct and accurate use of clock or watch	0-4
		0-12
b) Interpretation:	Calculation of water retained (water retained = 50cm^3 - volume drained).	0-4
	a) i) sand	0-1
	ii) large air spaces because of large particles	0-2
	b) i) clay/loam	0-1
	ii) small particles provide large surface area which retains a lot of water	0-2
	c) clay-small air spaces	0-2
	d) stops sand drying out so quickly stops clay becoming waterlogged.	0-2
		0-14

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No. 30 Cont'd

c) Work habits/ Responsibilities: Cleaning up work area and sinks after use ('messy') experiment!) 0-2

Disposing of soils outside and not in sink 0-1

Retiming funnels (minus cotton wool) and measuring cylinders in a clean condition. 0-1

Total 30

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